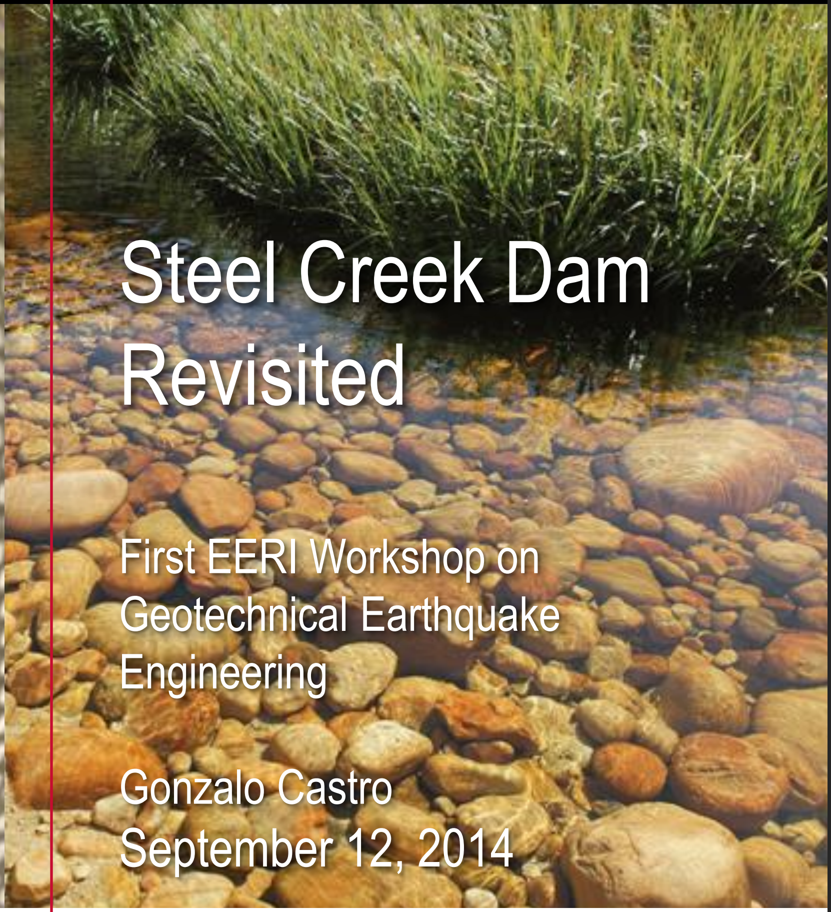
consulting engineers and scientists



Steel Creek Dam Revisited

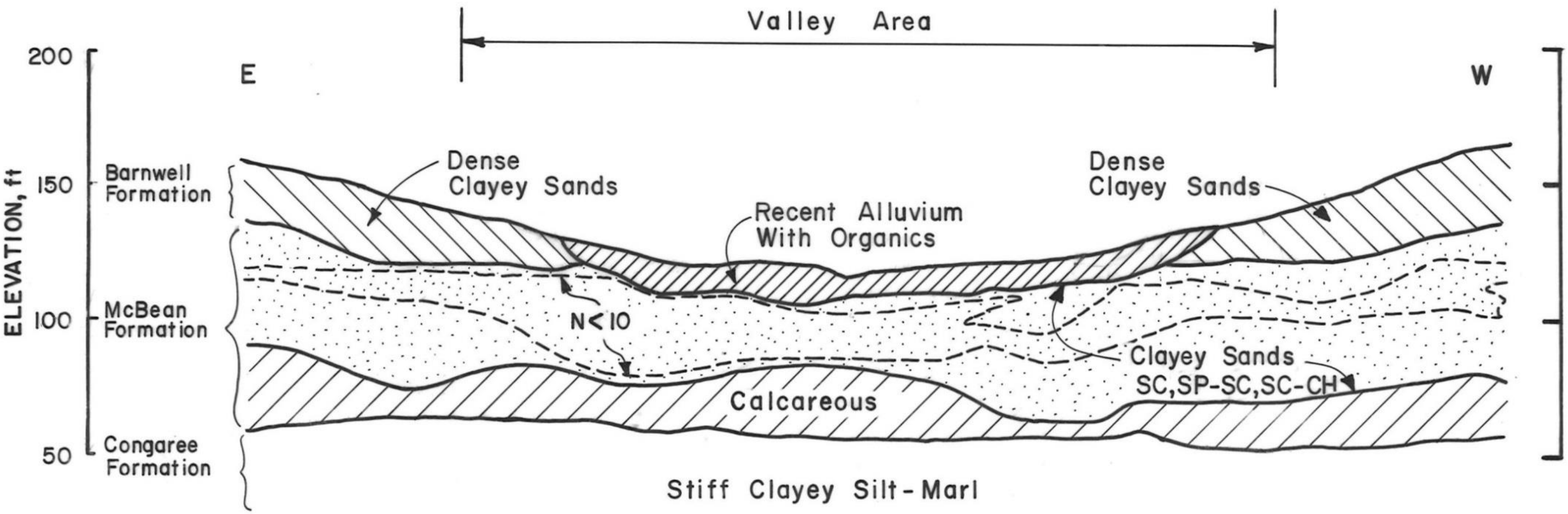
First EERI Workshop on Geotechnical Earthquake Engineering

Gonzalo Castro

September 12, 2014

GEI Consultants

Longitudinal Section, Foundation Conditions



Based On Mueser Rutledge Consulting Engineers' Soil Profile

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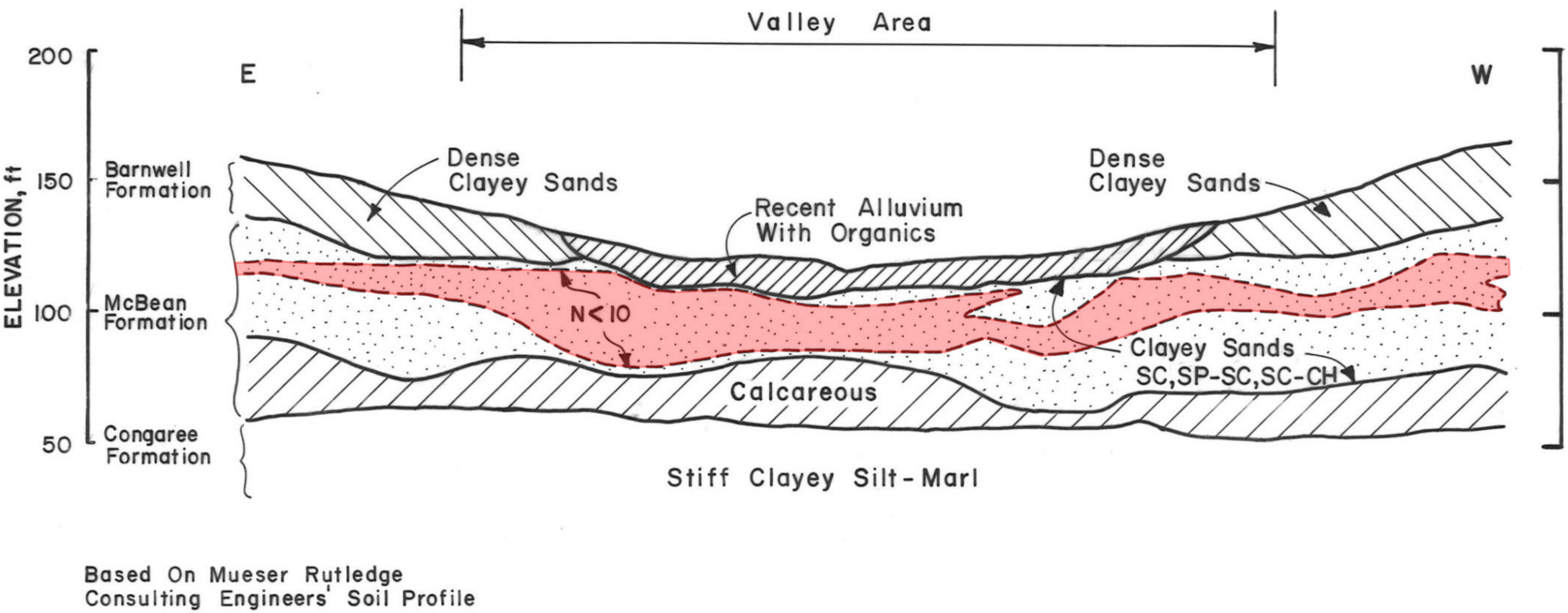
Foundation Sands with N < 10



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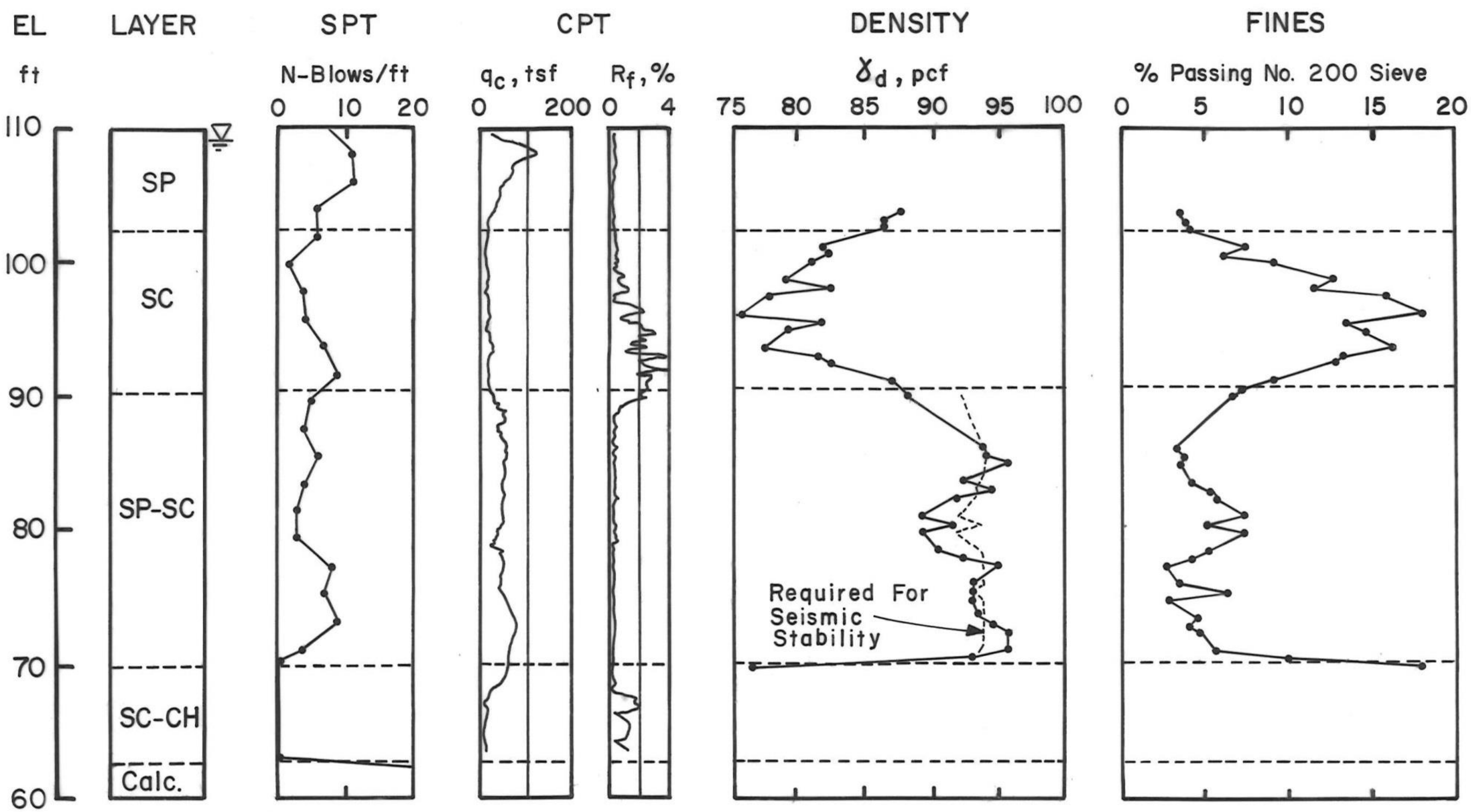
Typical Soil Profile in the Valley



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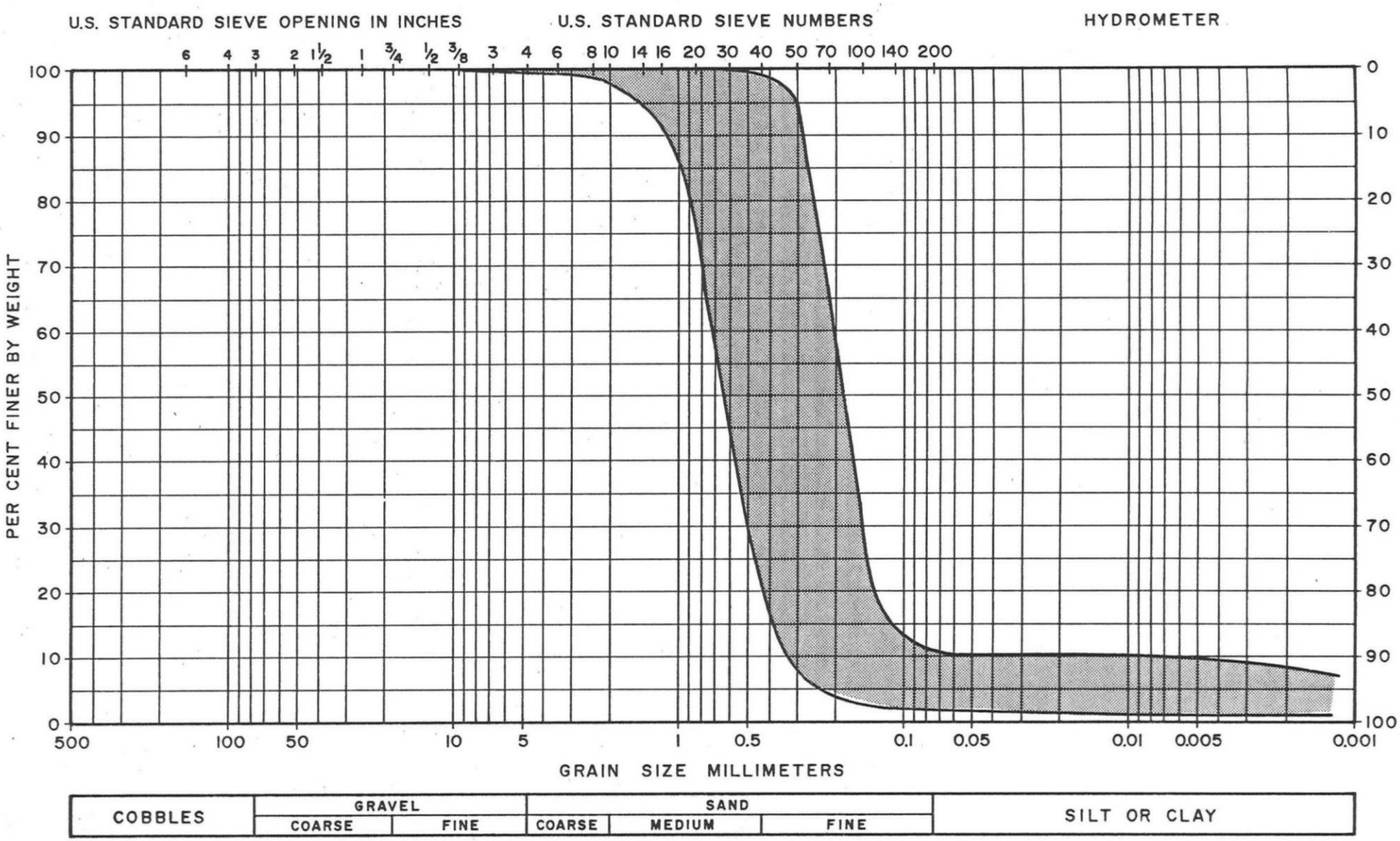
Gradation Range for SP – SC Layer



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Plasticity of Fines of SP-SC Sands

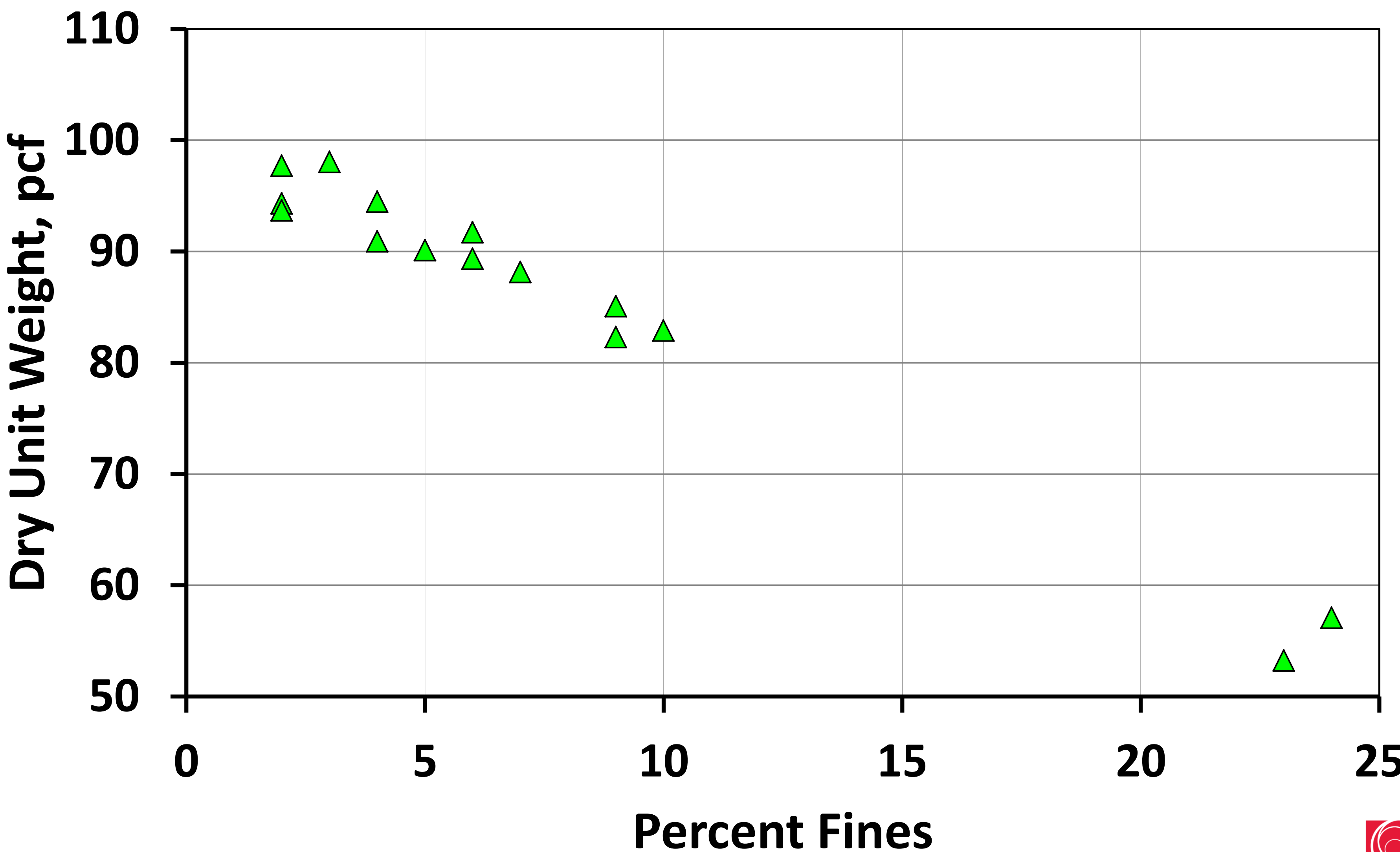
For the clay, i.e. the soil passing the Number 200 sieve, a test gave the following values:

Liquid Limit = 316

Plastic Limit = 50

Plasticity Index = 266

In Situ Dry Unit Weights



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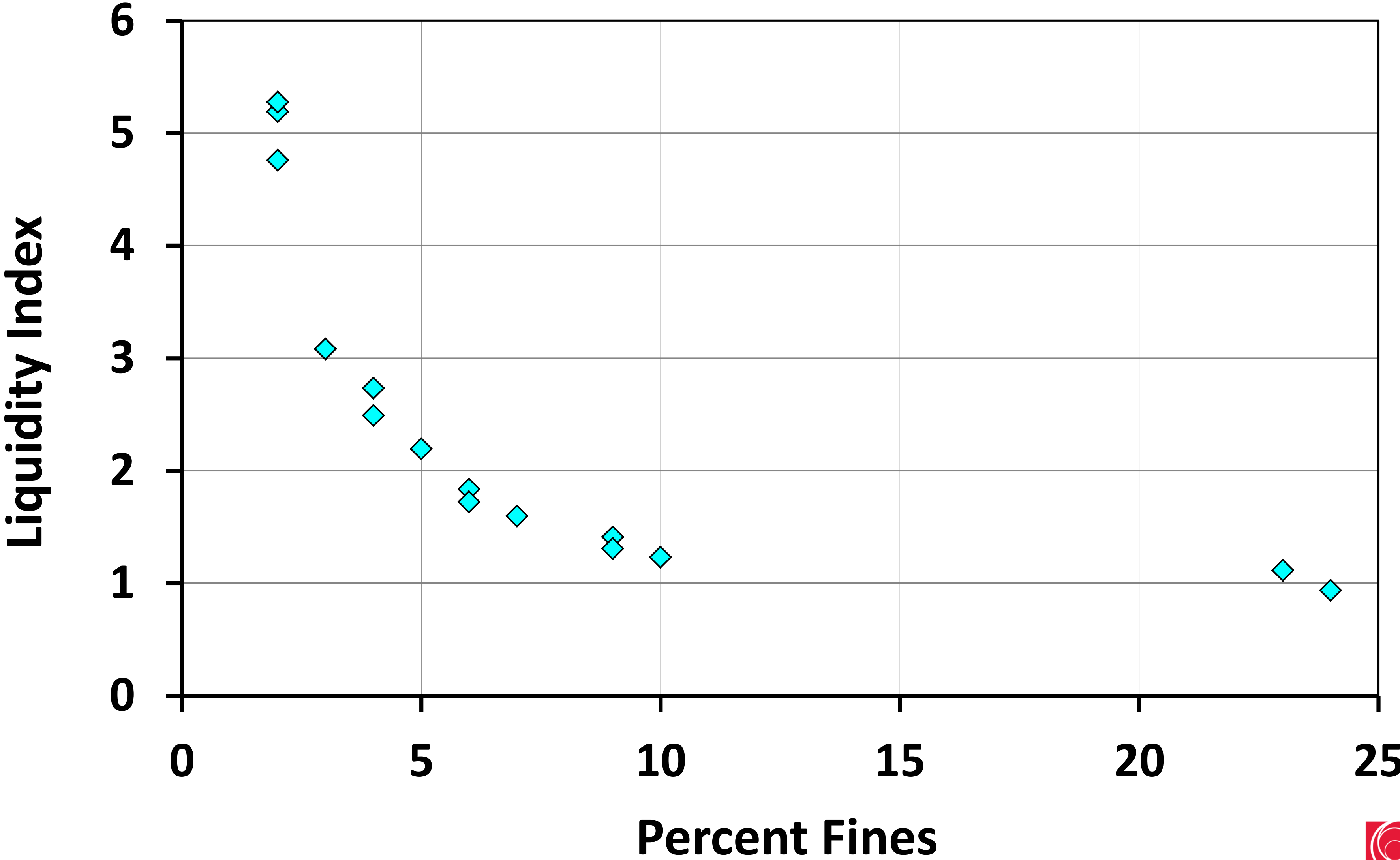
Liquidity Index for Clay Fraction



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Objective of Densification of Loose Soils

The main objective of densification was to preclude an instability failure, i.e. to require an Sus strength higher than the driving shear stresses

Soils Used on Tests to Estimate Potential for Compaction with Vibrations

Sample No.	Sample Identification	Soil Description	γ_d pcf	e
1	Clean sand from California. Tested for comparison purposes.	Widely graded SAND with <5% silty fines. Sub-angular to angular grains.	103	0.64
2	Undisturbed sand sample from Steel Creek Dam site. Boring S-102, Sample UD-10C, Depth 28.1 - 28.6 ft.	Fine SAND, 8% clayey fines. Several pockets of silt in middle of sample, Tan. SP-SC. (See Fig. 23 for grain size curve).	85.1	0.95
3	Undisturbed sand sample from Steel Creek Dam site. Boring S-103, Sample UD-7B, Depth 30.4 - 30.9 ft.	Fine to medium SAND, 2% clayey fines. Tan. SP. (See Fig. 24 for grain size curve).	98.8	0.68

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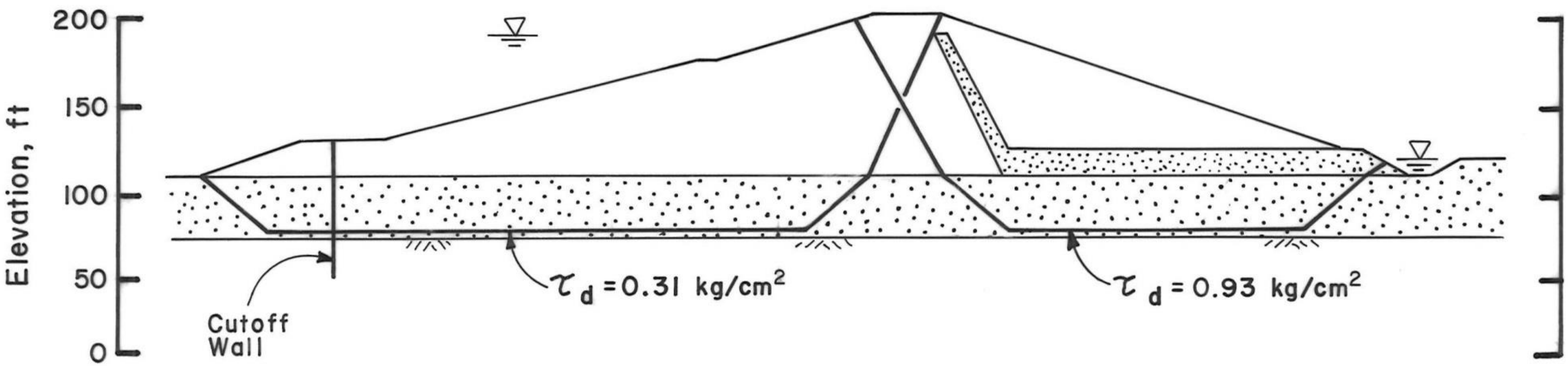
Average Driving Shear Stresses



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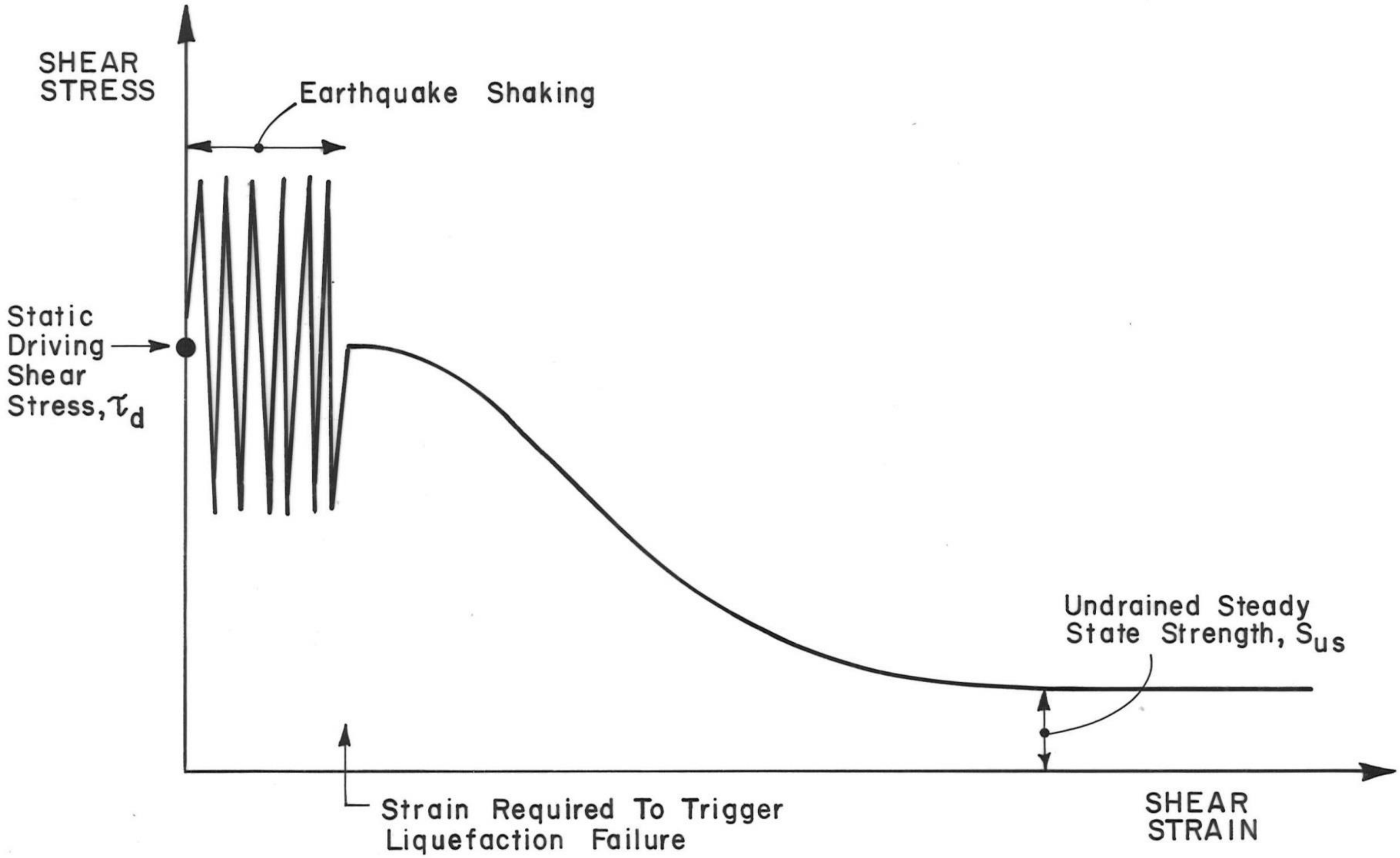
Schematic Stress Strain Behavior for Potentially Unstable Case



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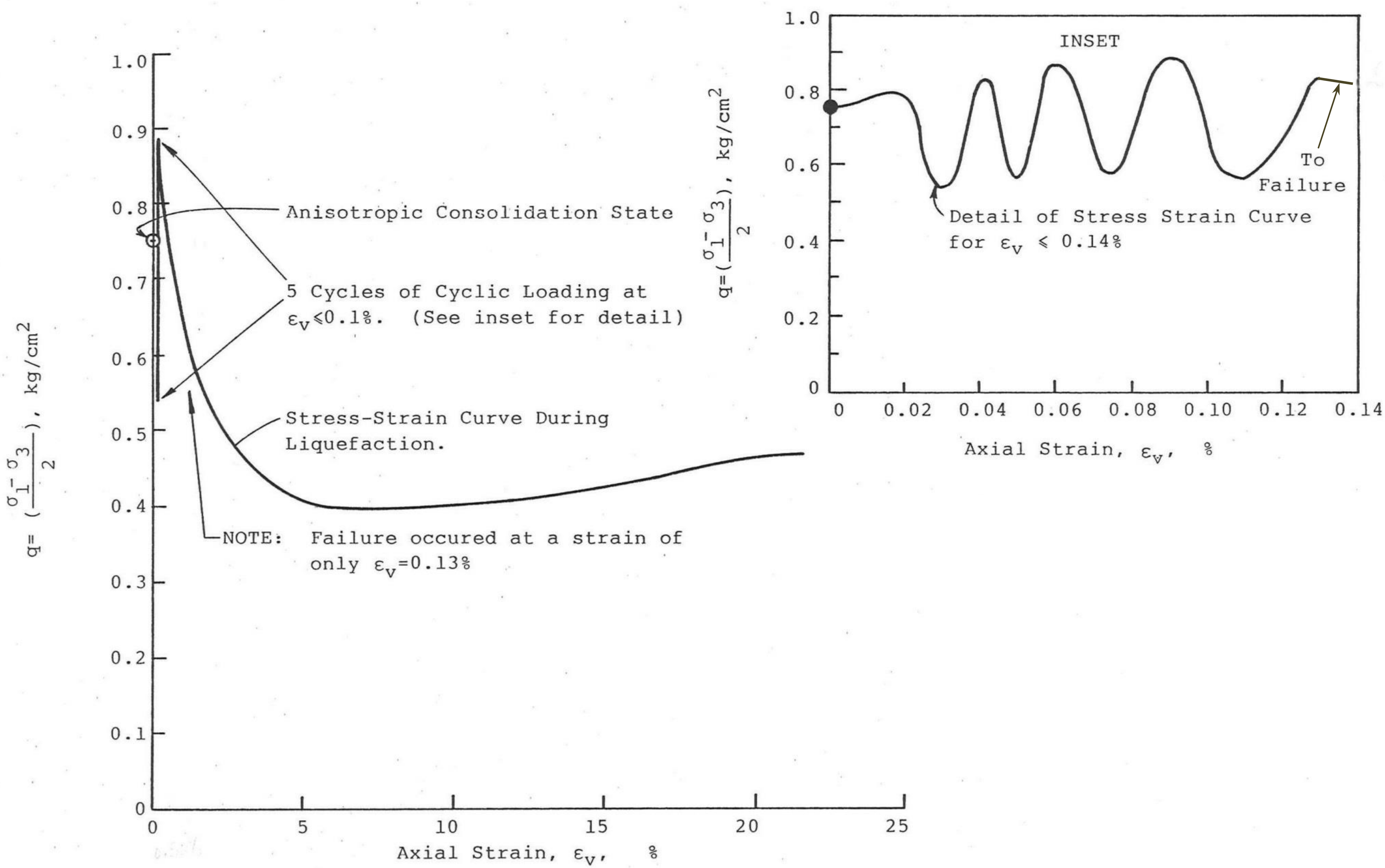
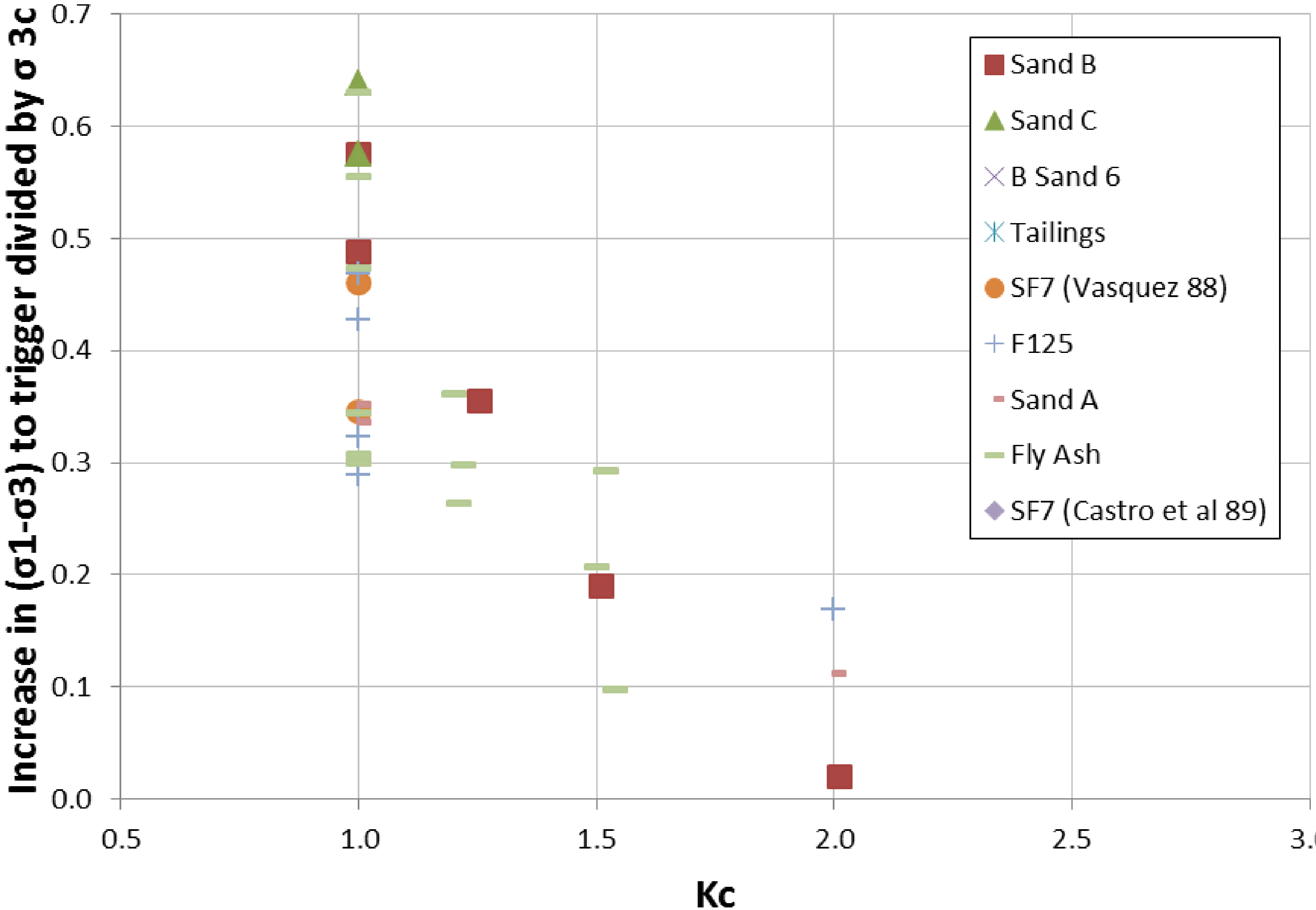
Typical Cyclic Test Results on the SP-SC Soil



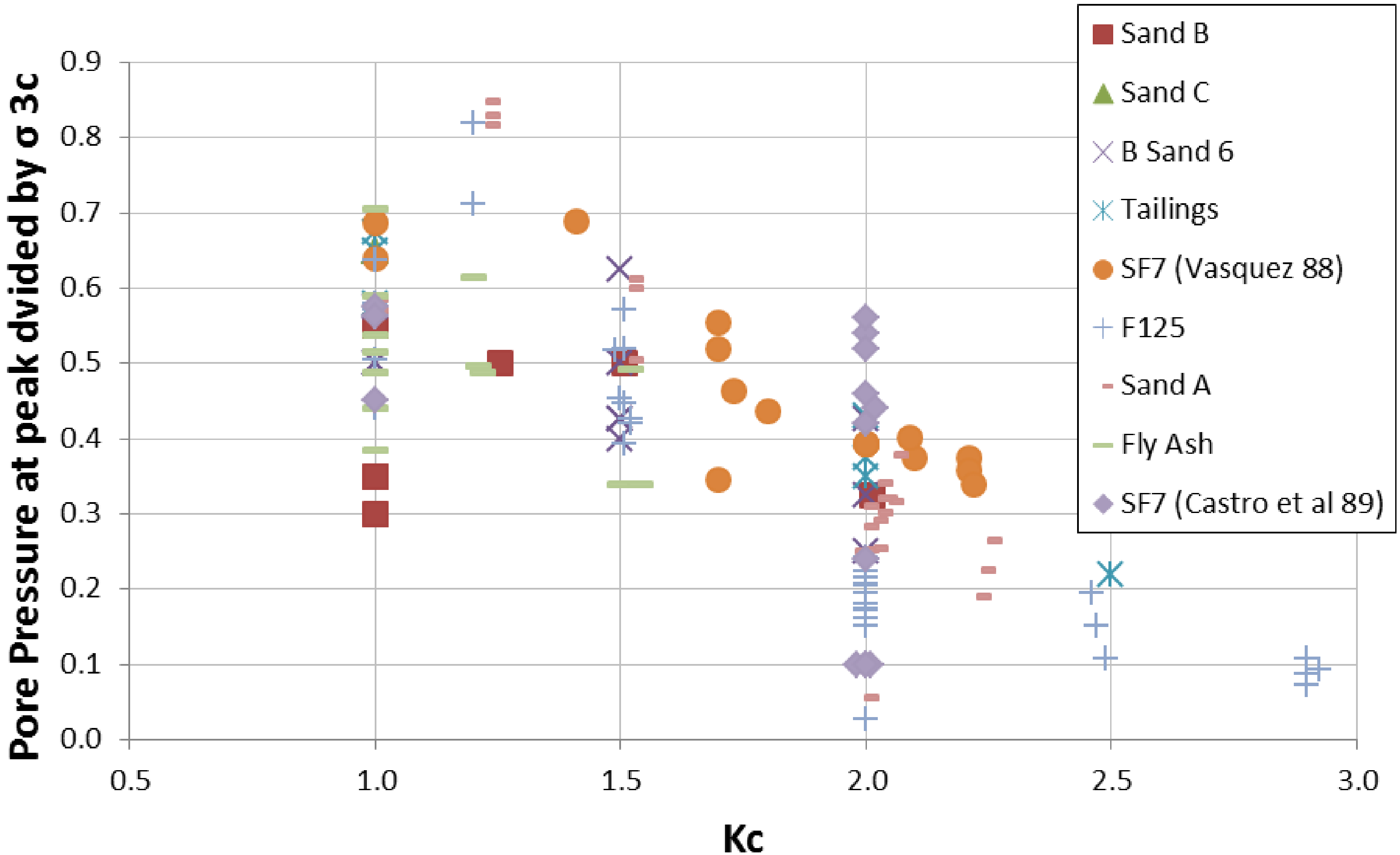
Increase in $(\sigma_1-\sigma_3)$ to trigger divided by σ_{3c}

Castro, 1994, revised



Triggering Pore Pressure

Castro, 1994, revised



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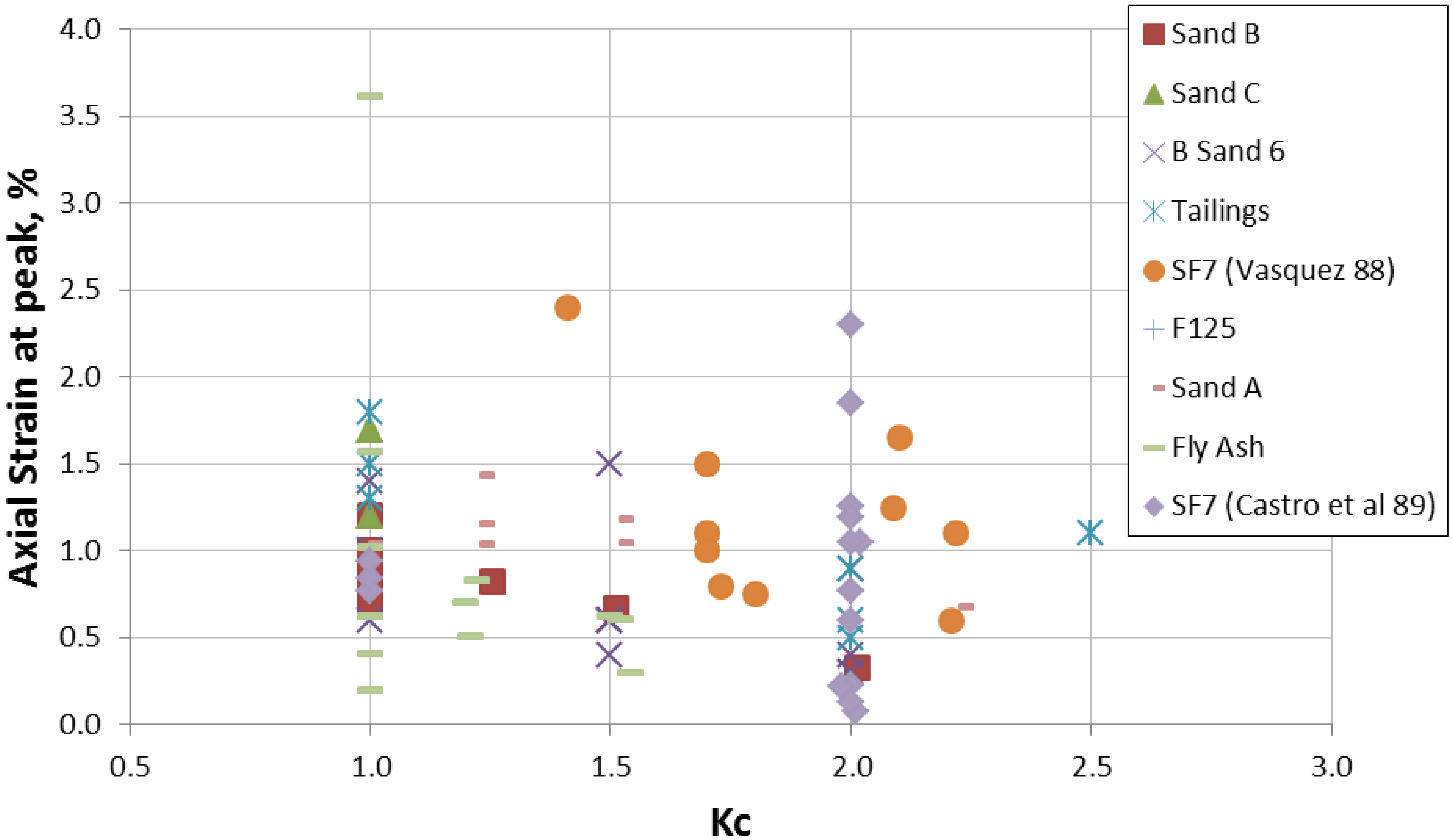
Triggering Strain



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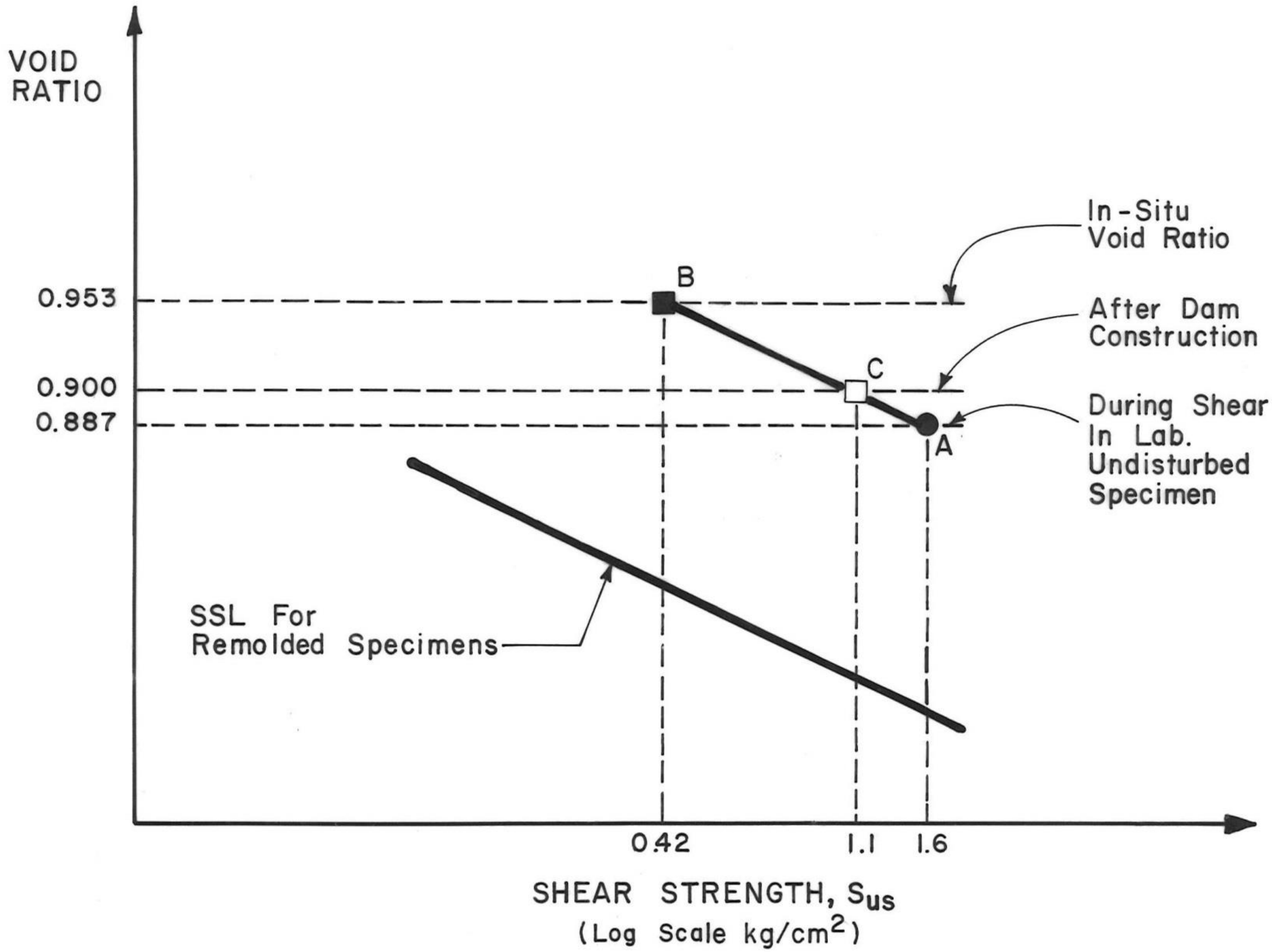
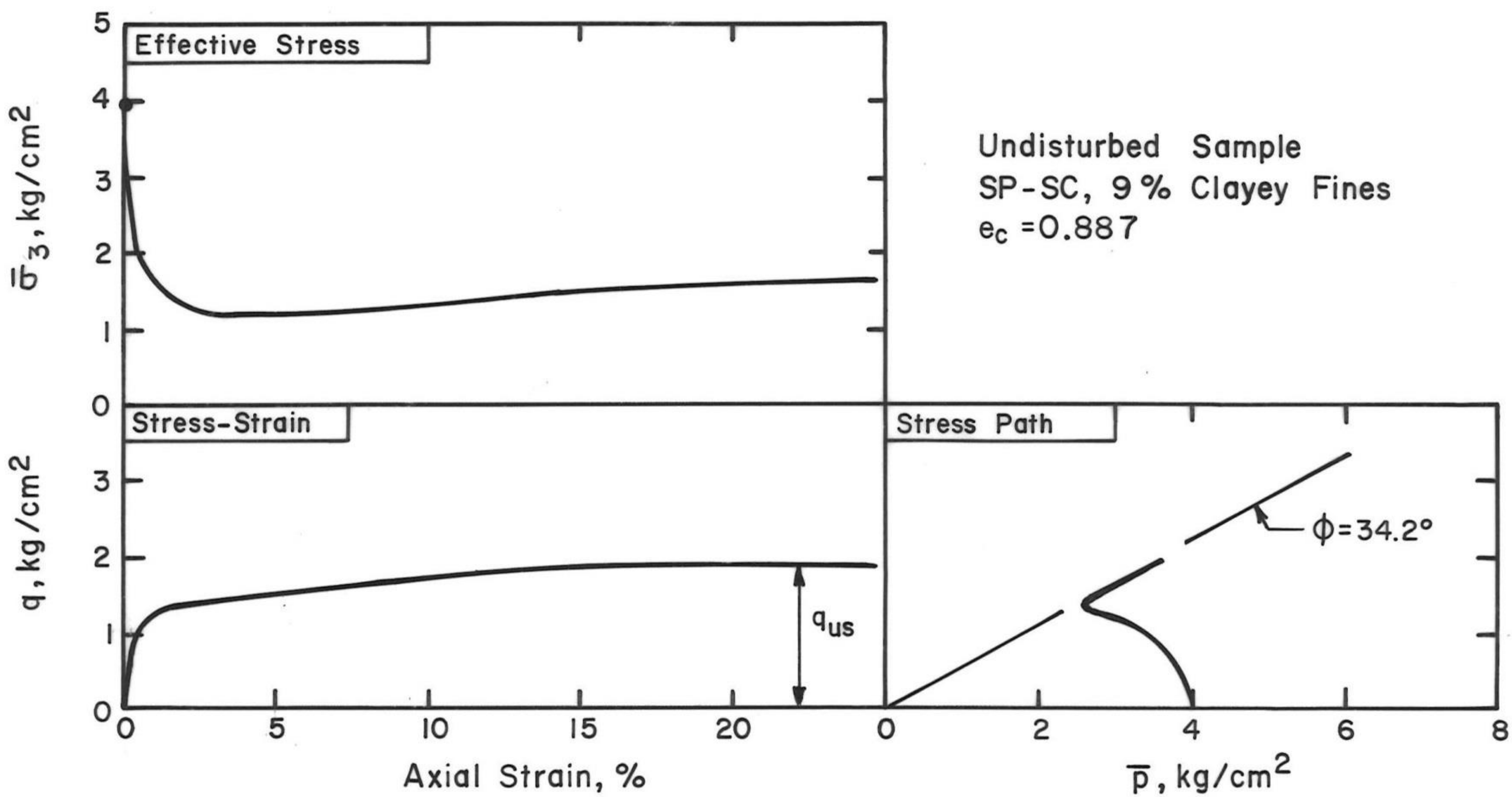
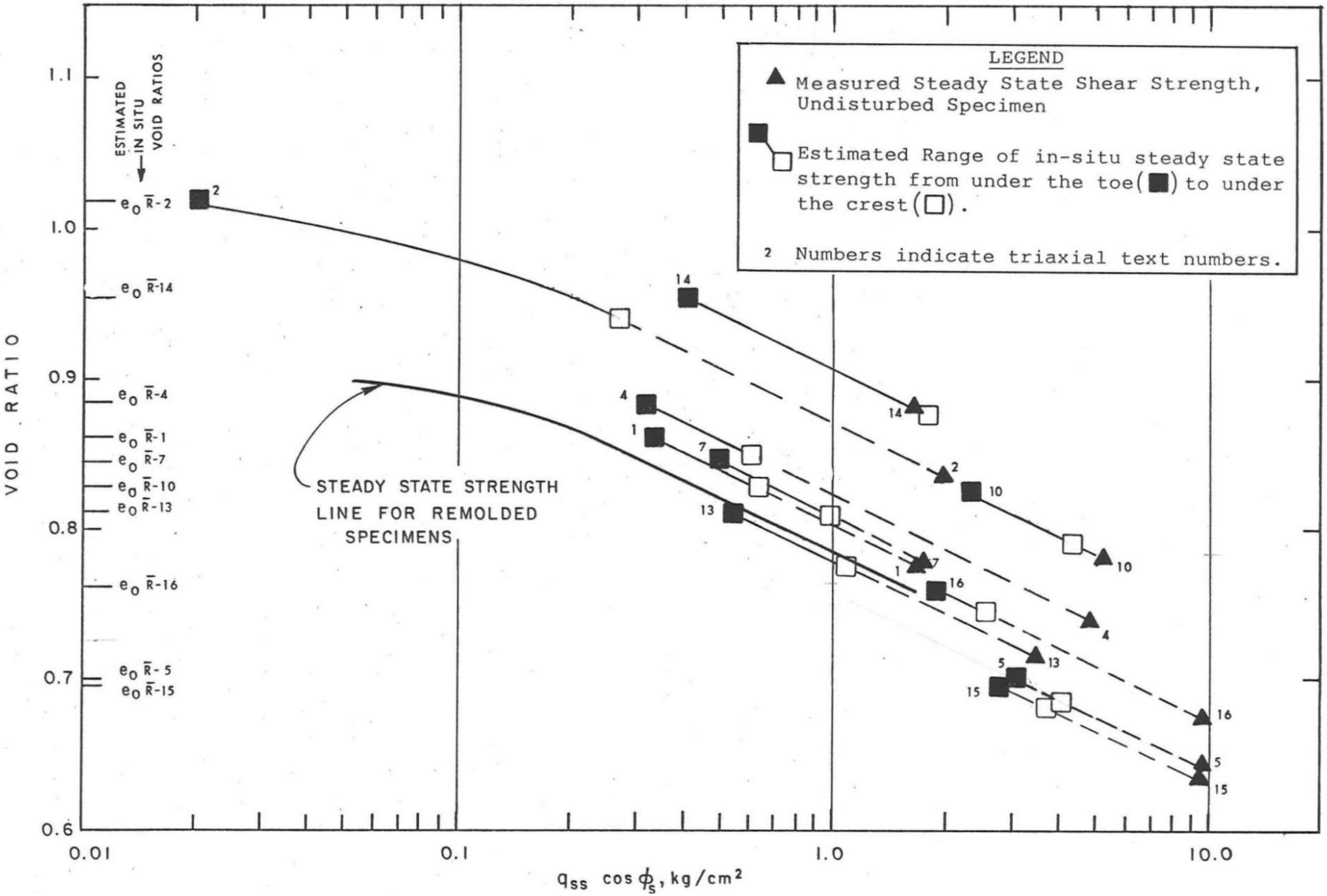
State Diagram



Typical Consolidated Undrained Triaxial Test



Results of “Undisturbed” Sample Tests



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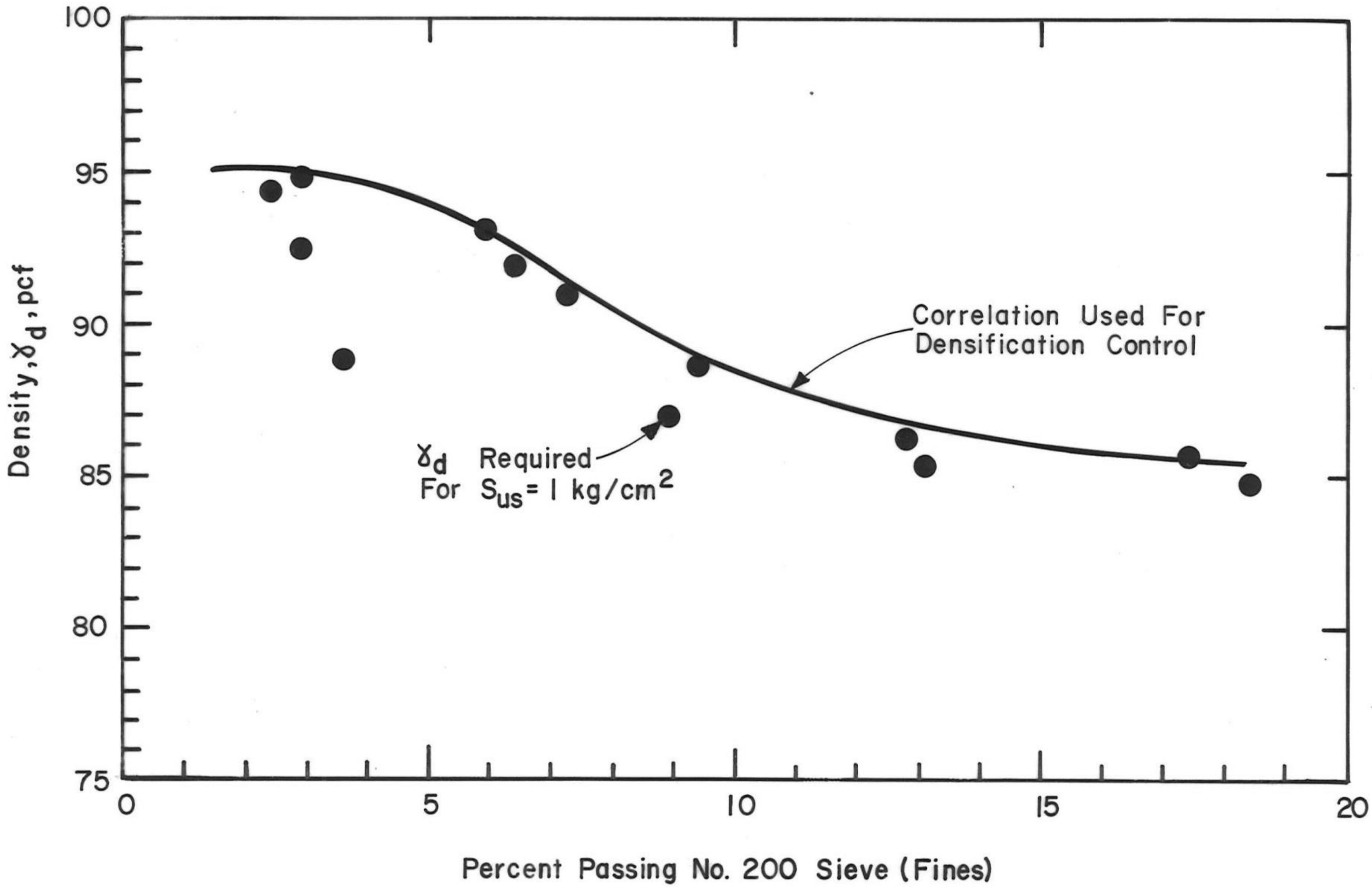
Density Required for Target Undrained Steady State Strength



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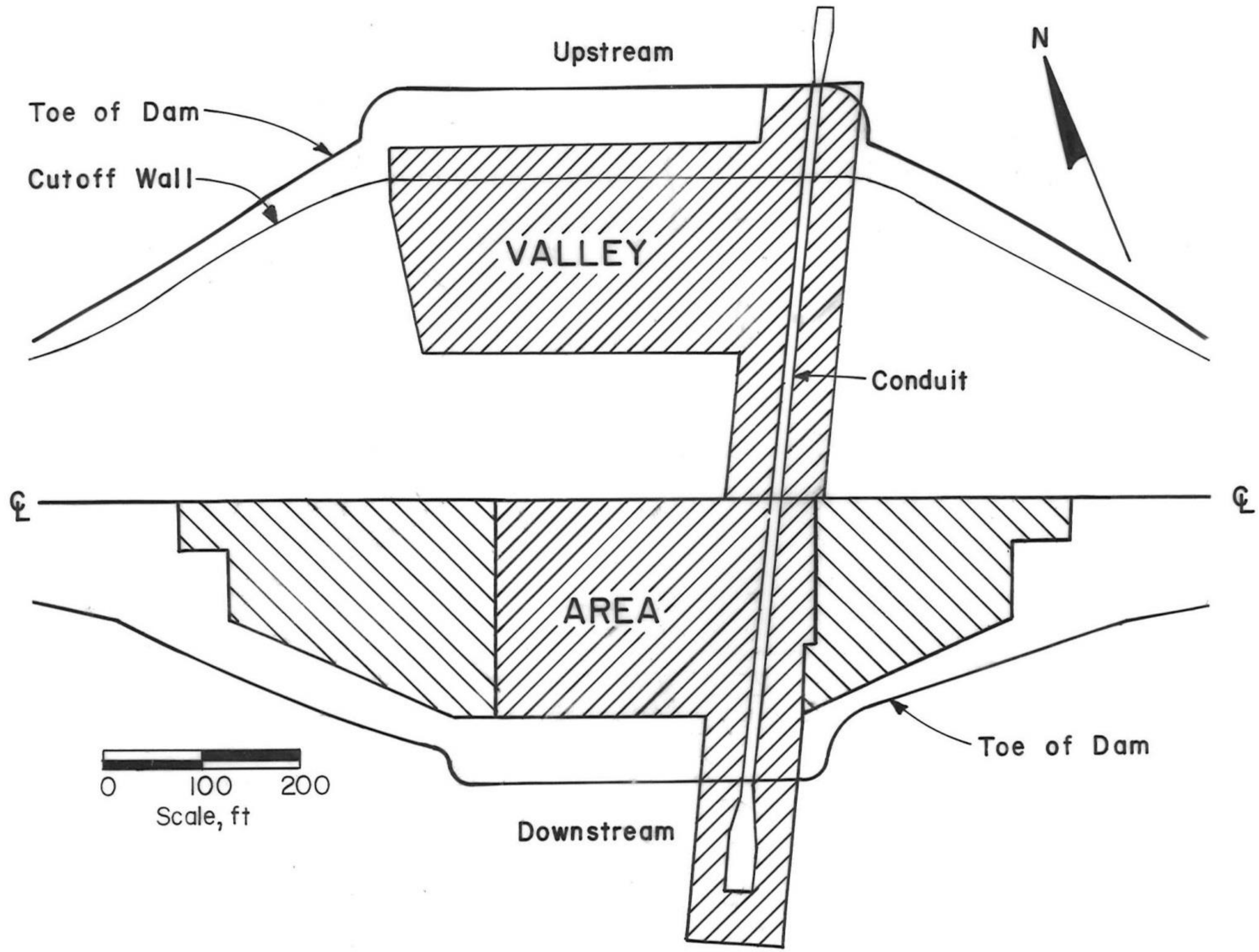
Foundation Compaction Scheme



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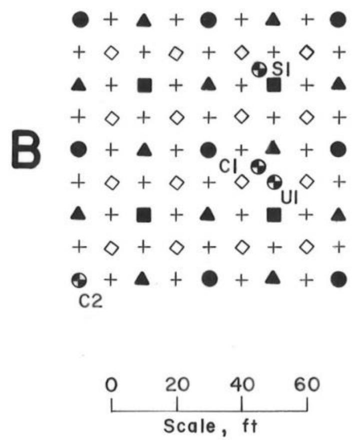
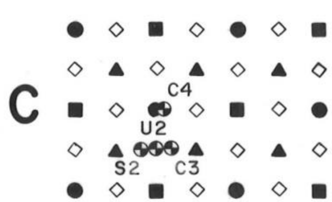
Dynamic Compaction Test Sections

Phase	Imprint	Number of Drops 17 ton, 58' drop
1	●	40
2	■	20



Phase	Imprint	Number of Drops 17 ton, 87' drop
1	●■▲◇	3
2	+	1
3	●	8
4	■▲◇	2
5	+	1
6	●	4
7	■	9
8	▲◇	3
9	●	15
10	■	7
11	●	20
12	■	16
13	▲	5
14	●	10
15	■	5
16	▲	17
17	◇	4



Phase	Imprint	Number of Drops 17 ton, 50'	17 ton, 100'	30 ton, 90' drop
1	●■▲◇	2	-	-
2	●■	-	10	-
3	●■▲◇	2	-	-
4	●	-	-	40
5	■	-	-	16
6	●	-	-	25
7	▲	-	-	9
8	Ironing			

Imprints : ● Primary, ■ Secondary, ▲ Tertiary, ◇ Quaternary

⊕ U - Undisturbed Sample Boring, S - SPT Boring, C - CPT Sounding

(Only Borings and Soundings Referred to in the Text are Shown)

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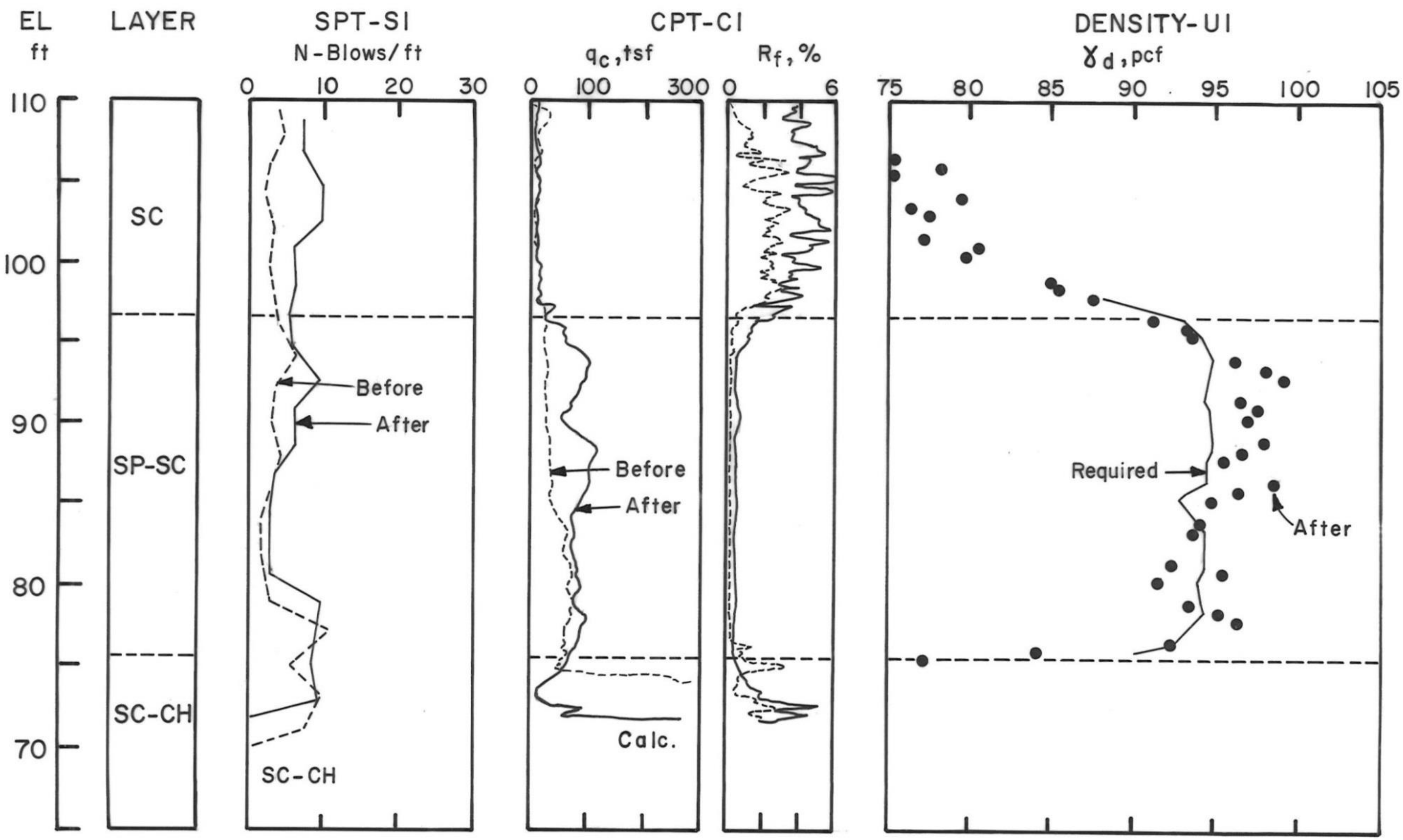
Effects of Dynamic Compaction, Test Plot B
Mid Point Location



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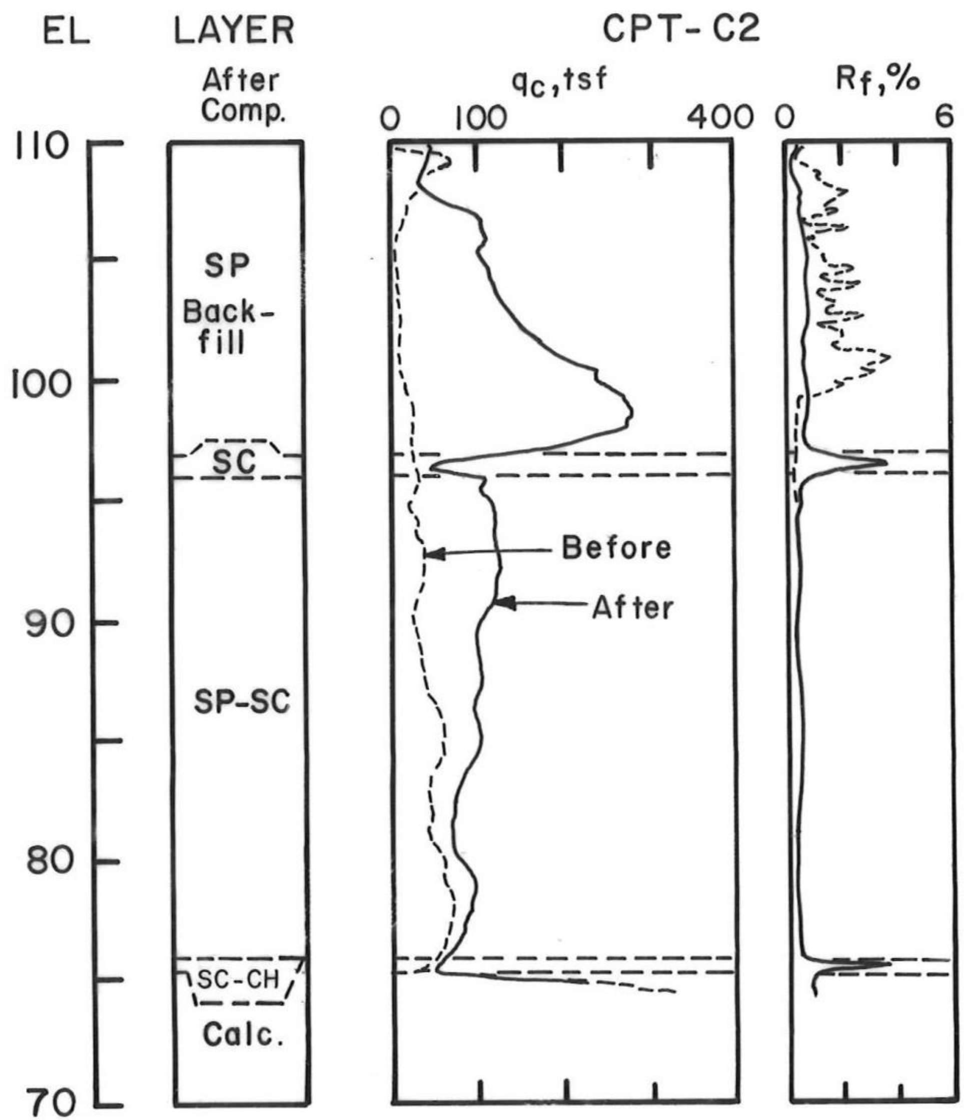
Dynamic Compaction Effects, Test plot B
Primary Imprint Location



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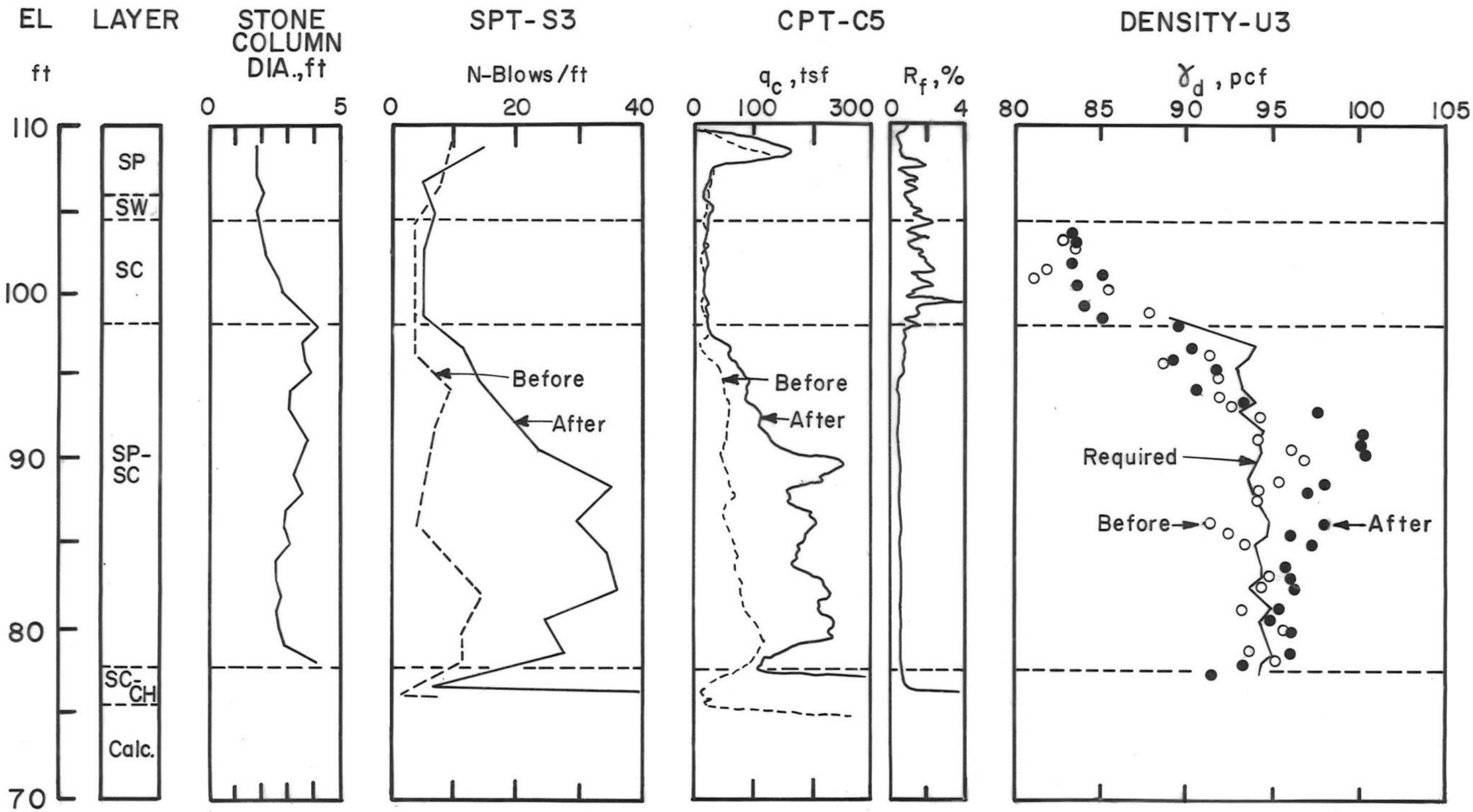
Dynamic Compaction Effects, Test Plot C
Mid Point Location



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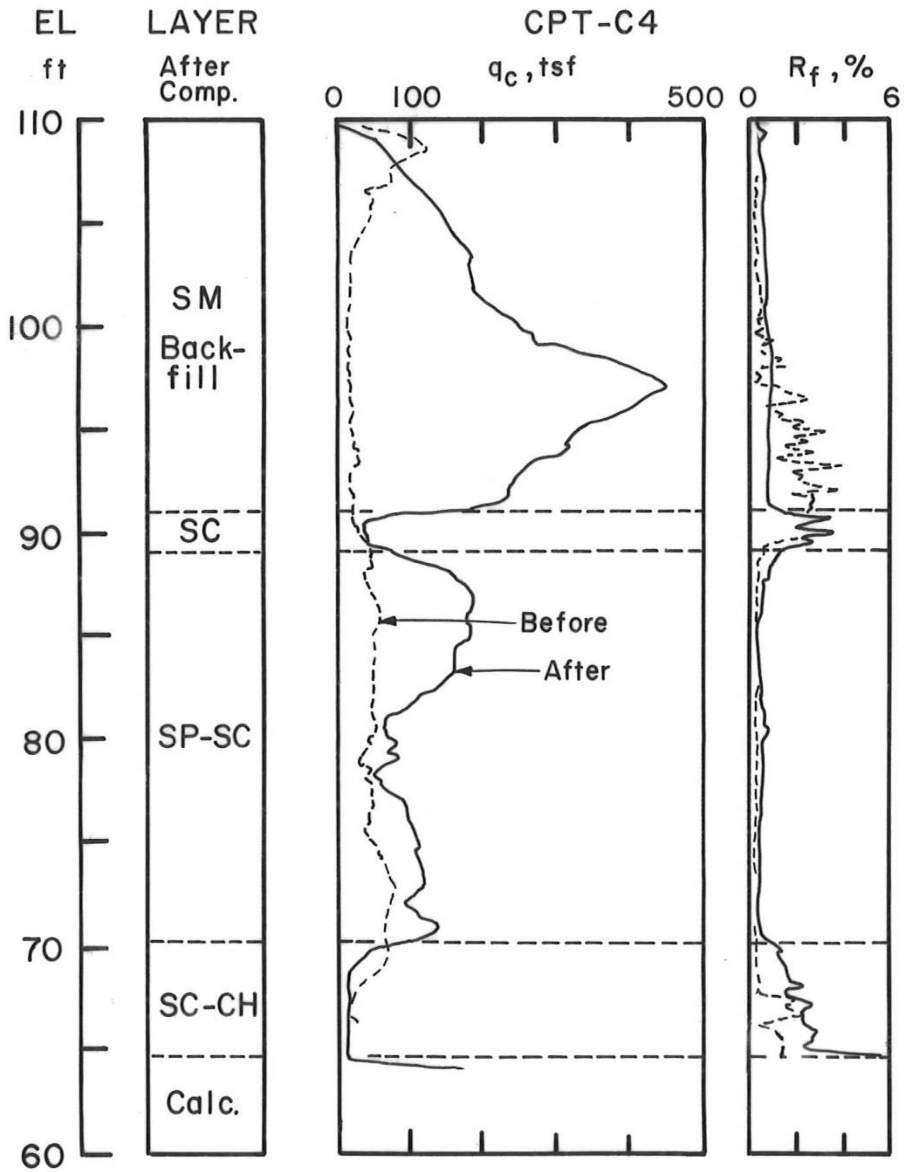
Dynamic Compaction Effects, Test Plot C
Primary Imprint Location



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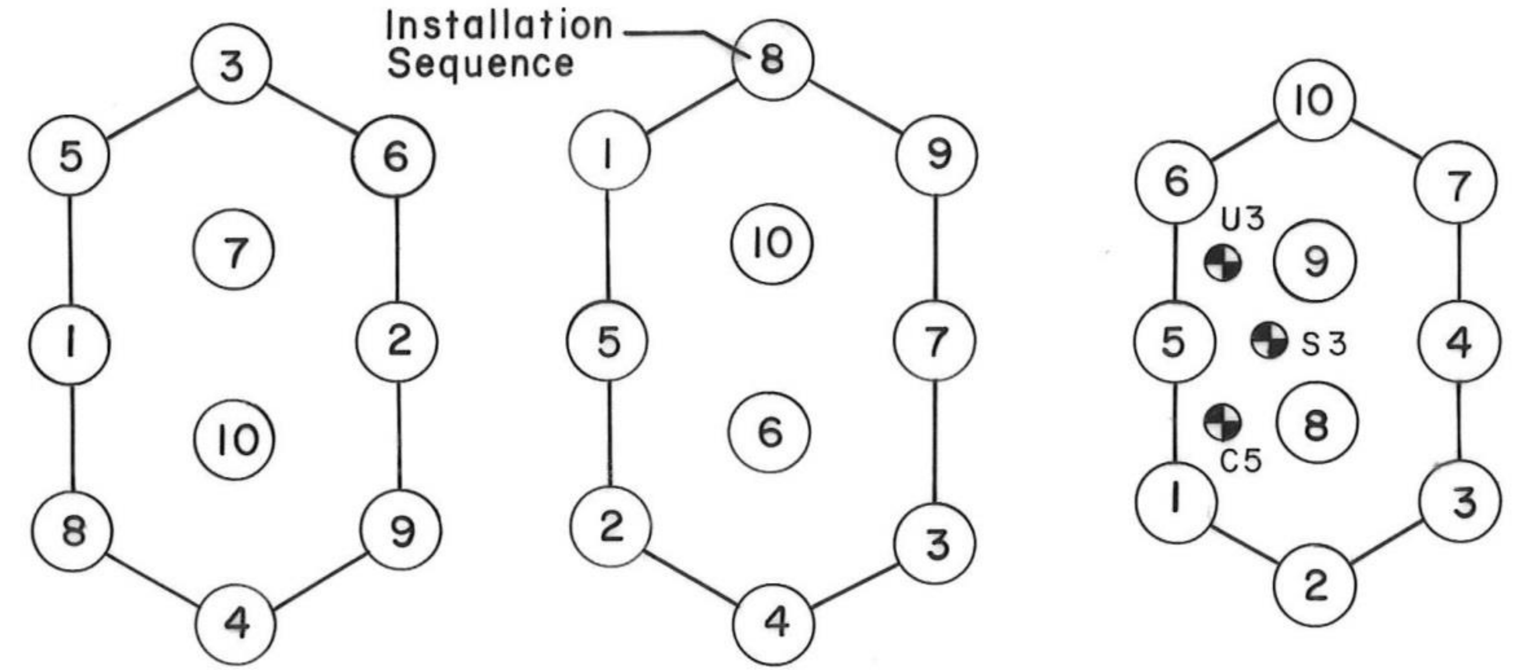
Stone Column Test Sections



TEST PLOT A
7 ft. Spacing
140 Amps

TEST PLOT B
7 ft. Spacing
160 Amps

TEST PLOT C
6 ft. Spacing
140 Amps

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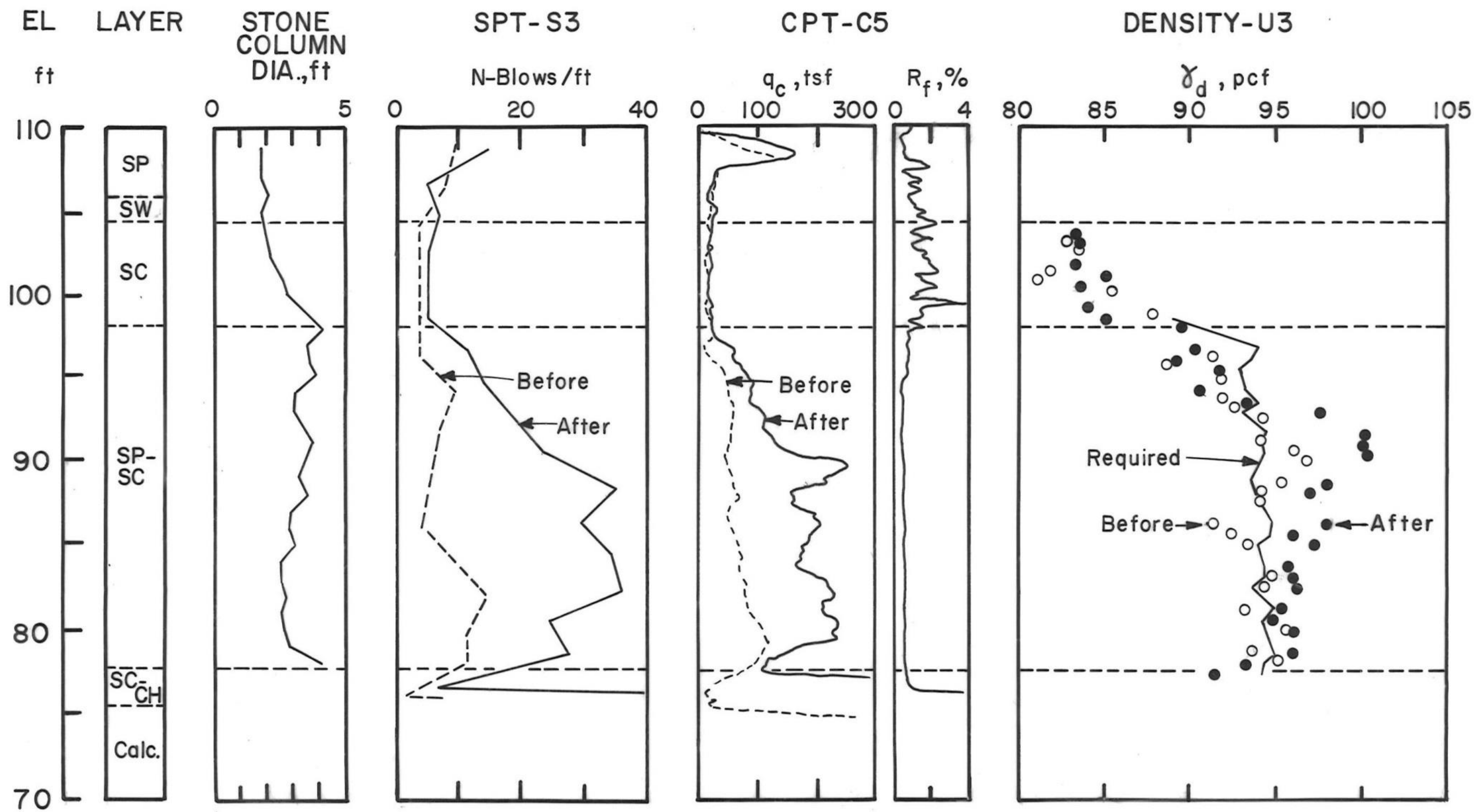
Stone Column Effects, Test Plot C



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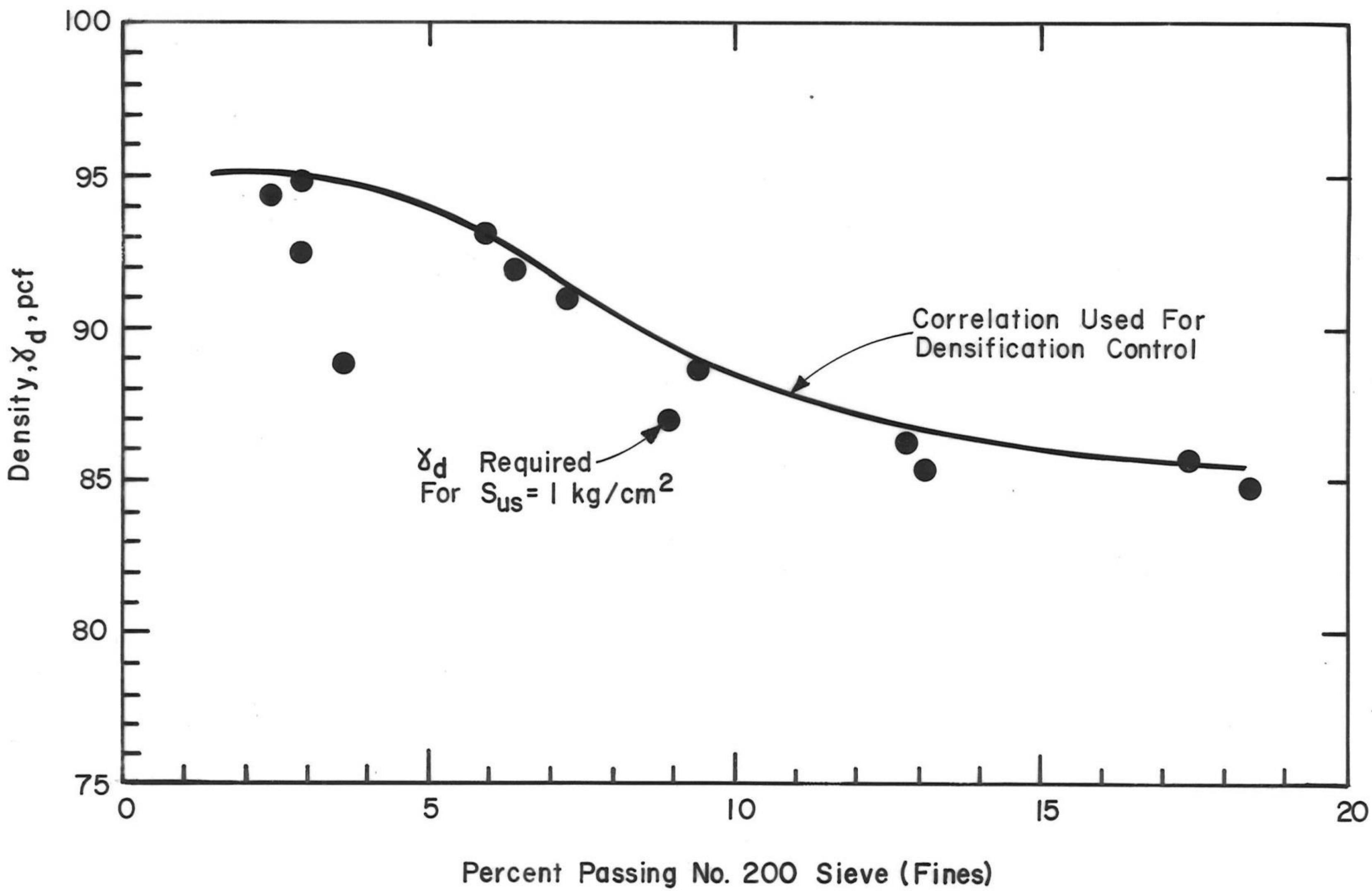

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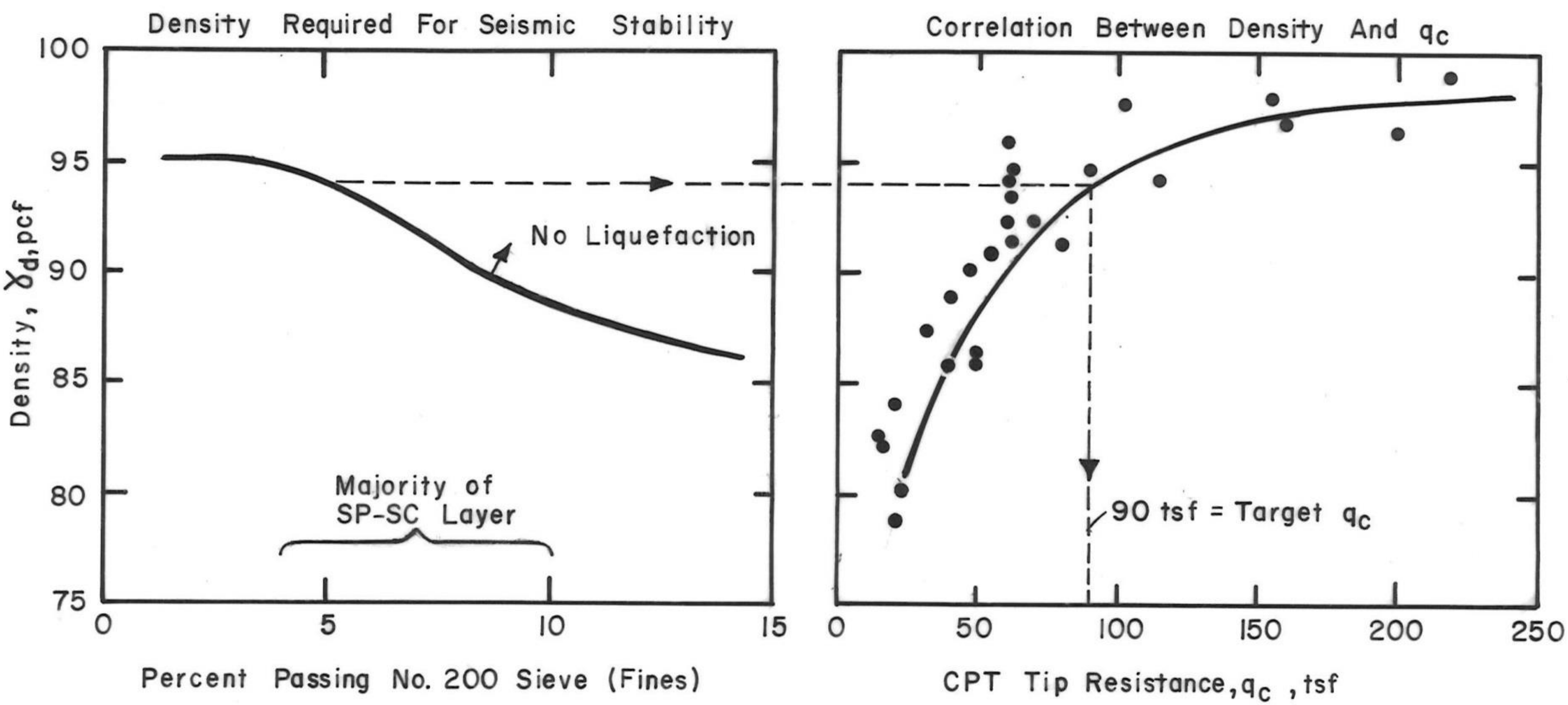
Field Control Criteria



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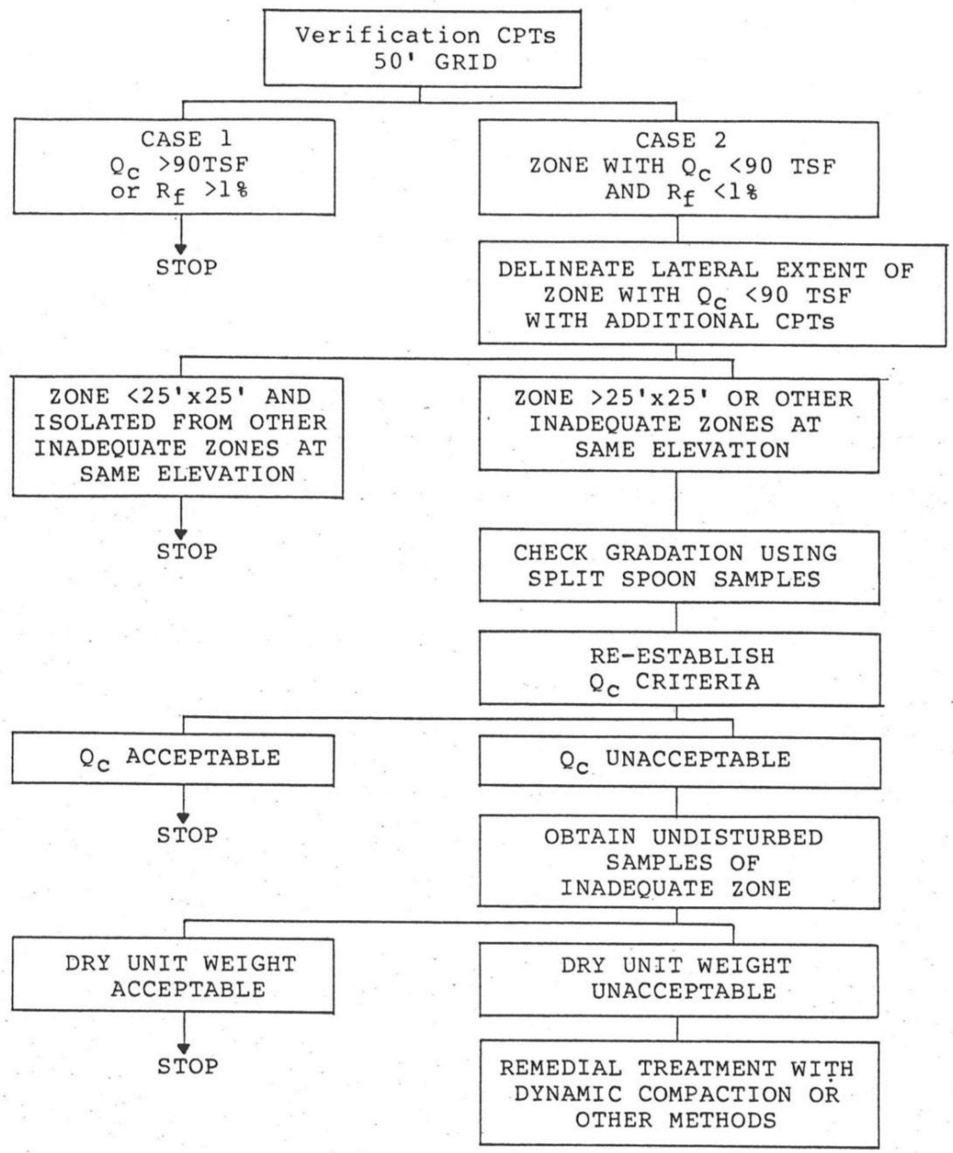
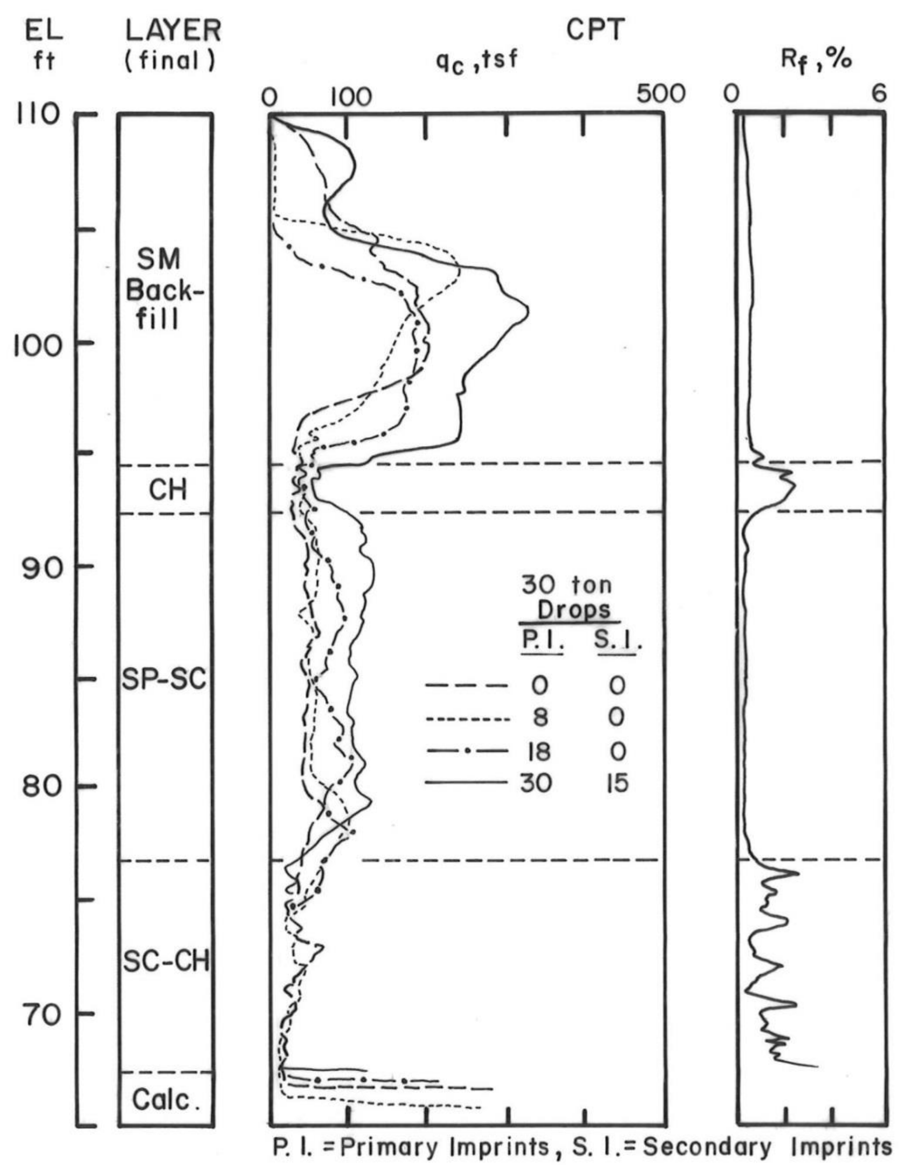


Q_c - CPT Tip Resistance
R_f - CPT Friction Ratio

Dynamic Compaction Effects, Production (Similar to Test Area C). Primary Imprint Location



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